An Implantable Semiconducting Glucose Sensor Electrode

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Introduction

Many studies (1-3) were carried out in search of enzymatic and amperometric glucose sensor electrodes. These sensors are not suitable for long term implantation due to inherent loss of enzyme activity. In this study we report a non-enzymaic semiconducting tin oxide electrode which is a potential candidate for implantable as well as non-disposable glucose sensor. This sensor works on the basis of electroreduction of glucose to sorbitol (4).

Experimental

Simulated blood plasma electrolyte of pH 7.4 at 37 °C was prepared using cations: Na^+: 150 mM; K^+:5 mM; Mg^{+2}: 1.5 mM and anions: Cl^-: 126 mM; HCO_3^-: 36 mM; HPO_4^{-2}:

Human blood plasma from a donor was obtained from the Central Blood Bank, Pittsburgh, PA. Dextrose or d-glucose solution was made by dissolving 500 mg of glucose in 10 mL of simulated blood plasma electrolyte (pH = 7.4) in a 10 mL flask.

For the electrochemical measurements of cyclic votammogram, a 1.00 cm^2 area tin oxide (sensor), a platinum wire (area 1.25 cm^2) and. Ag/AgCl were used as the working, counter and the reference electrodes respectively. All measurements were carried out at physiological temperature of 37 ± 1 °C both in simulated blood plasma as well as in human blood plasma. All experiments in human blood plasma was carried out by enclosing the working sensor electrode in a semi-permeable membrane in order to avoid the fouling by macromolecules in the plasma.

Results and Discussions

The increase of current density on added glucose concentration in human blood plasma is shown in Fig.1. The glucose concentration dependent currents were found stable for the tested period of 480 minutes (see Fig. 2). These results indicate that this sensor electrode has the potential to be used as implantable as well as non-disposable glucose sensor electrode.

References

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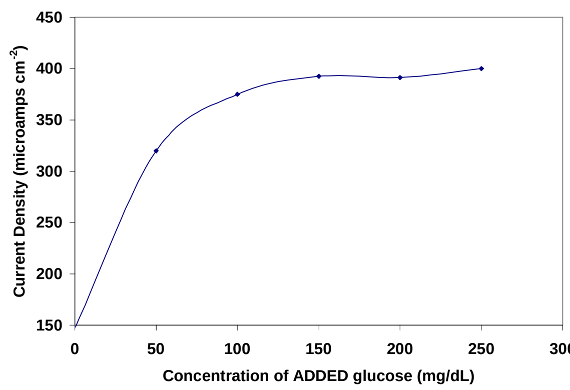

Fig. 1. Plot of current density (μA cm^{-2}) vs. added glucose concentration/dL of human blood plasma.

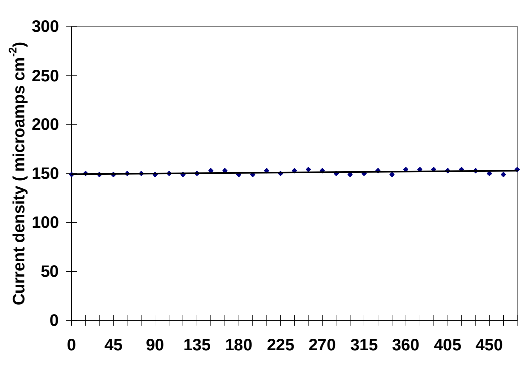

Fig. 2. Current density (μA cm^{-2}) as a function of time (minutes): human blood plasma at added glucose concentration of 150mg/ dL of plasma